NEC

TTS 37B

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INSTRUCTION MANUAL

MODEL

TTS 37B

NOISE - LEVEL - VU MEASURING SET

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 - CONCORD, N. H. 03301

AREA CODE 603 224-7466

INSTRUCTION

MANUAL

MODEL

TYPE 1259
NOISE - LEVEL - ONE
MEASURING SET

INSTRUCTION MANUAL

MODEL

TTS 37B

NOISE - LEVEL - VU MEASURING SET

SERIAL 4401 AND ABOVE

ISSUE 2

AUG. 1972

NORTHEAST ELECTRONICS CORPORATION

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INSTRUCTION MANUAL

MODEL

TYPE 1512
NOISE - LEVEL - VU
MEASURING SET

ISSUE 3
AUG 1972

NORTHEAST ELECTRONICS CORPORATION
P.O. BOX 126 - CONCORD, N.H. 03301
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SECTION 1

DESCRIPTION

1.1 GENERAL. The Model TTS 37B is a compact, transistorized set designed to measure a wide range of transmission levels, VU, and noise. It has a sensitivity range of -95 dBm and -5 dBrn. Switchable filters are provided internally to either attenuate the low frequency band around 60 Hz and its harmonics, or to attenuate frequencies above the voice band. A filter which provides C-Msg weighting is also included. Provisions for dialing out on a line are available, as is a hold coil for holding the circuit.

1.2 Two monitor jacks are provided. The first provides a DC output which may be used to drive a 1 mA recorder. The second jack provides an AC output which may be used to drive an impulse noise measuring set, a telephone headset to determine the nature of the signal, or to drive external circuits, thereby using the Model 37B as a variable, high gain amplifier.

1.3 The sensitivity of the set can be varied from -80 dBm to +20 dBm in 1 dB and 10 dB steps by means of two attenuators; these attenuators are also calibrated in dBrn from 0 to 100 dBrn in blue numbers for easy identification. Circuits of either 600 or 900Ω, balanced or unbalanced, can be measured in either a terminated or bridging condition.

1.4 Noise to ground can be measured with a 40 dB loss; a longitudinal drain is supplied. A BATT TEST pushbutton switch is provided which measures the condition of the internal batteries and determines if 48V is properly connected. A diode is provided to protect the internal circuits against damage in the event the wrong polarity of 48V is inadvertently applied.

1.5 The set is equipped with two 9-volt batteries which provide approximately 230 hours of life. It can also be operated from 48V station battery.

NOTE

This instrument provides approximate VU measurements, The meter balistics have not been accurately calibrated to provide precise readings.

SECTION 2

SPECIFICATIONS

2.1 METER. A $4\frac{1}{2}$" meter with several scales is provided as follows:

a. Scale tracking accuracy (+3 to -3 dB on meter): ±0.15 dB maximum error.

b. VU-dB scale calibrated in black divisions and numbers from +3 to -15 dB. Between +1 dB and -1 dB, the scale is calibrated in 0.1 dB divisions; 0.2 dB between +1 and +3 and -1 and -3 dB; 0.5 dB divisions are used between -3 and -10 dB; 1 dB divisions are used between -10 and -15 dB.

c. The dBrn scale markings are the same as dB scale with blue numbers from +13 to -5 dBrn.

d. A VU quality scale is marked in three colors: Green between 0 and +3 dB; yellow between -6 and 0 dB; red between -15 and -6 dB.

e. A BATT TEST scale with a green arc to indicate GOOD.

2.2 RANGE OF MEASUREMENTS

a. Level Measurements: +23 dBm to -95 dBm.

b. Noise Measurements: 113 dBrn to -5 dBrn.

c. Noise to Ground Measurements: 113 dBrn to -5 dBrn.

2.3 INPUT IMPEDANCES - Balanced input transformer.

a. Terminated: 600 or 900Ω ±5% with phase angle of less than 5° when hold coil is out.

b. Bridging: 12,000Ω on 600Ω circuit
15,000Ω on 900Ω circuit

c. Longitudinal Drain: Across the line - 85,000Ω
To Ground - 100,000Ω.

2.4 FREQUENCY RESPONSE. The frequency response for designated positions of the FILTER switch, normalized to 1 kHz at room temperature, is as follows. (See Figs. 2-1 and 2-2).

C MSG: -3 dB from 625 to 710 Hz and 2800 to 3100 Hz
-40 dB from 85 to 115 Hz and 6000 to 7000 Hz

HIGH PASS: Not less than 45 dB rejection at 60 Hz
-3 dB from 13 kHz to 16 kHz with 18 dB/octave slope at higher frequencies.

3 kHz: ±0.25 from 100 to 1000 Hz
-3 dB from 2.8 kHz to 3.2 kHz with 18 dB/octave slope at higher frequencies.

15 kHz: ±0.25 dB from 100 to 5000 Hz
-3 dB from 13 kHz to 15 kHz with 18/dB octave slope at higher frequencies.

2.5 ATTENUATOR ACCURACY: (Reference to 0 dBm setting): ±0.15 dB from +10 dB to -60 dB. ±0.3 dB from +20 dB to -70 dB.

2.6 HOLD CIRCUIT. A low resistance hold coil can be switched in or out. At frequencies below 200 Hz, this coil will have an effect on the response characteristic and will therefore effect the accuracy of measurements.

2.7 AC MONITOR OUTPUT

a. Output Impedance: 600Ω

b. Output Level: approx. -10 dBm when meter reads 0 dB

2.8 DC MONITOR OUTPUT

a. The DC output is approx. 0.7 mA when meter reads 0 dBm.

b. The DC resistance of the external measuring circuit, such as a recorder,

should not exceed 300Ω and must be isolated from ground.

2.9 STABILITY OF CALIBRATION

a. Stability with Temperature (with respect to readings at 25°C):

±0.1 dB from 20°C to 30°C
±0.3 dB from 0°C to 50°C

b. Stability with Battery Voltage within green BATT TEST arc on meter:
0.05 dB change

2.10 POWER REQUIREMENTS

a. Battery operation: requires two 9-volt Eveready 2356 batteries or equivalent. Current drain approximately 11 mA (without AC monitor).

b. Battery life: Intermittent use: approximately 230 hours; continuous use: approximately 210 hours

c. 48V operation: requires 48V office battery. Disconnects internal battery when 48V jack is utilized. Current drain approximately 35 mA.

2.11 SIZE: 8" x 11" x 10"

2.12 WEIGHT: 14 lb.

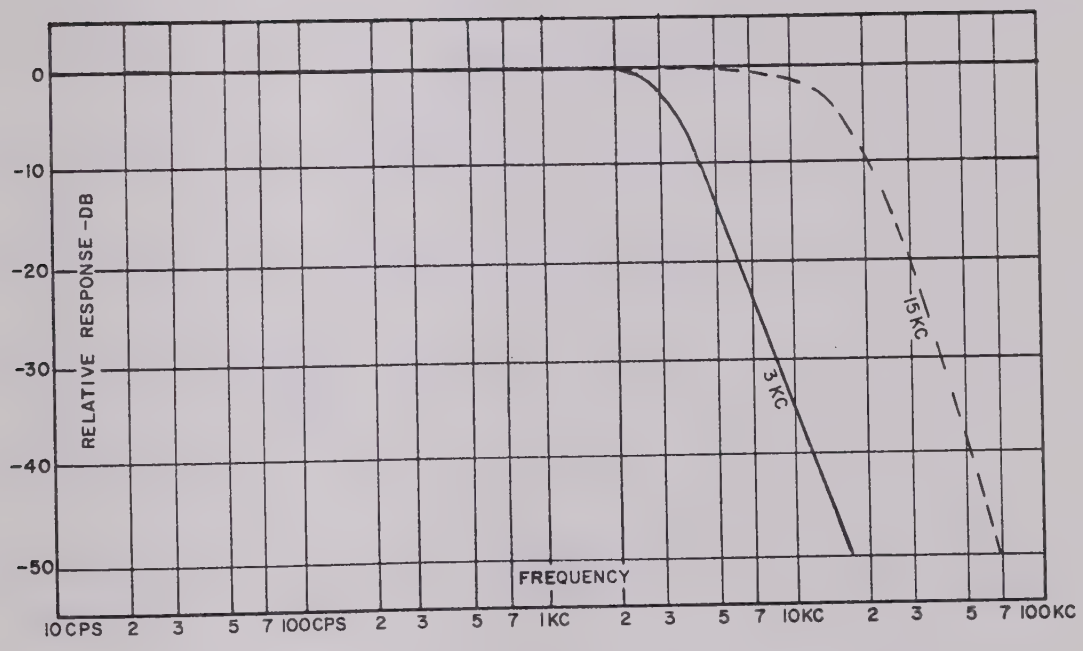


Figure 2-1 Frequency Response with 3KC and 15KC Filters

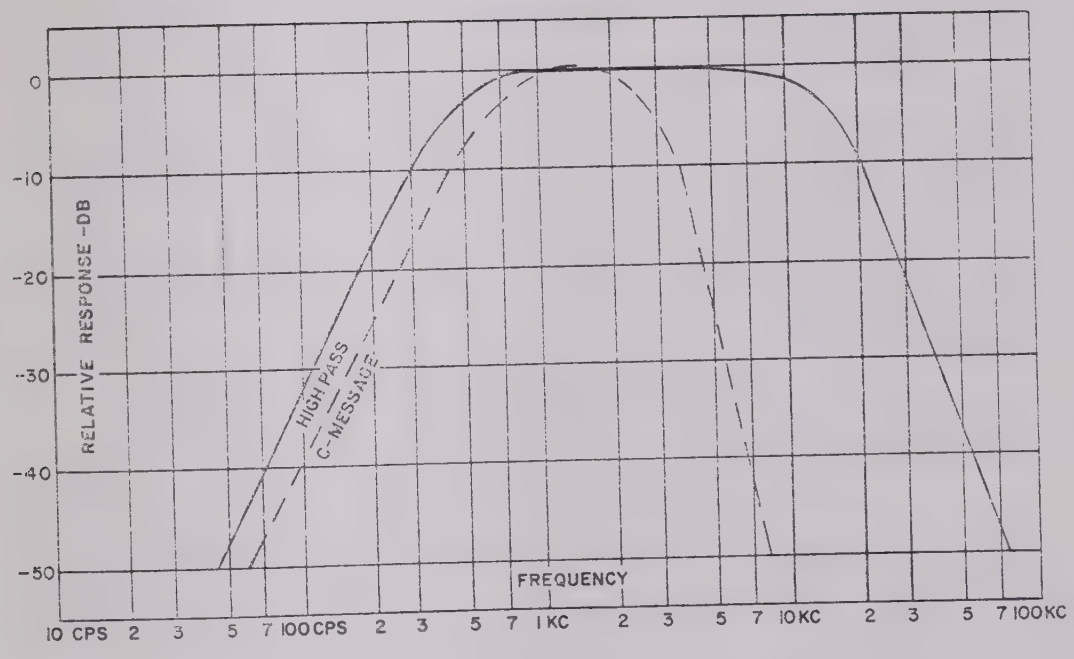


Figure 2-2 Frequency Response with C-Message and High Pass Filters

SECTION 3

OPERATING INSTRUCTIONS

3.1 FRONT PANEL CONTROLS. Table 3-1 and Fig. 3-1 describe and locate the front panel controls on the TTS 37B.

Ref Desig.	Name of Control	Type of Control	Use or Purpose
1	POWER	Toggle switch	Connects the internal battery to the circuits.
2	48V	Telephone jack	Provided to allow connection of central office battery to set.
3	BATT TEST	Pushbutton switch	Connects the meter to the battery test circuit which indicates the condition of the batteries.
4	HOLD	Toggle switch	When switch is ON, a hold coil is connected across the line jack and terminals.
5	MON (AC)	Telephone jack	Provided to allow connection of a telephone headset to monitor the tone being measured.
6	MON (DC)	Telephone jack	Provided to allow connection of an external DC monitor (recorder or meter) device in series with the meter.
7	FILTER	Rotary switch	Selects desired filter to be presented to the signal being measured.
8	SENS (1 dB/step) SENS (10 dB/step)	Rotary switches	To adjust the amount of gain necessary in the set to obtain a meter reading. Greatest accuracy is obtained when the upper portion of the meter is used.
9	INPUT	Rotary switch	To select the function of the input circuits.

Ref Desig.	Name of Control	Type of Control	Use or Purpose
10	LINE	Binding posts	Provided to allow connection to the input when using a GR type connector.
11	LINE	Telephone jack	Provided to allow connection to the input when using a telephone plug.
12	GND	Binding post	Provided to allow connection to the chassis of the set.
13	DIAL	Telephone jack	Provided to allow connection of a dial or subscriber set with a dial to the LINE jack when the INPUT switch is in the DIAL & TALK position.

3.2 OPERATING INSTRUCTIONS.

3.3 LEVEL MEASUREMENTS

a. Open lid (may be detached by moving to right).

b. Turn POWER ON.

c. Depress BATT TEST pushbutton switch and note if meter needle falls in green arc marked GOOD. Replace batteries with Eveready 2356 or equivalent if step 3 indicates bad.

d. Set INPUT switch to desired impedance.

e. Set FILTER switch to 15 KC.

f. Connect circuit to be tested to either the LINE jack or LINE binding posts.

g. Set SENS attenuator switches to obtain a convenient reading on meter. A more accurate measurement may be obtained if the meter needle falls between the black numerals +3 and -3 dBm.

h. The level is the algebraic sum of the SENS switches reading (BLACK NUMBERS ONLY) and the meter reading (BLACK NUMBERS ONLY). Likewise, the SENS switches readings are the algebraic sum of the black numerals.

EXAMPLE:

SENS Switches	Meter Reading	Level
+7 BLACK	+2 BLACK	+9
+15 BLACK	-3 BLACK	+12
0 BLACK	-1.6 BLACK	-1.6
-10 BLACK	+2.4 BLACK	-7.6
-15 BLACK	-0.6 BLACK	-15.6

i. To monitor the tone being measured, insert a 310 plug connected to a telephone headset in the AC MON jack. (This output jack can be connected to a 600Ω impedance receiving device with little effect on meter reading.)

3.4 NOISE MEASUREMENTS

a. Follow steps a through f under 3.3.

b. Set SENS switches to 85 (blue numbers).

c. Connect circuit to be tested to either LINE jack or LINE binding posts.

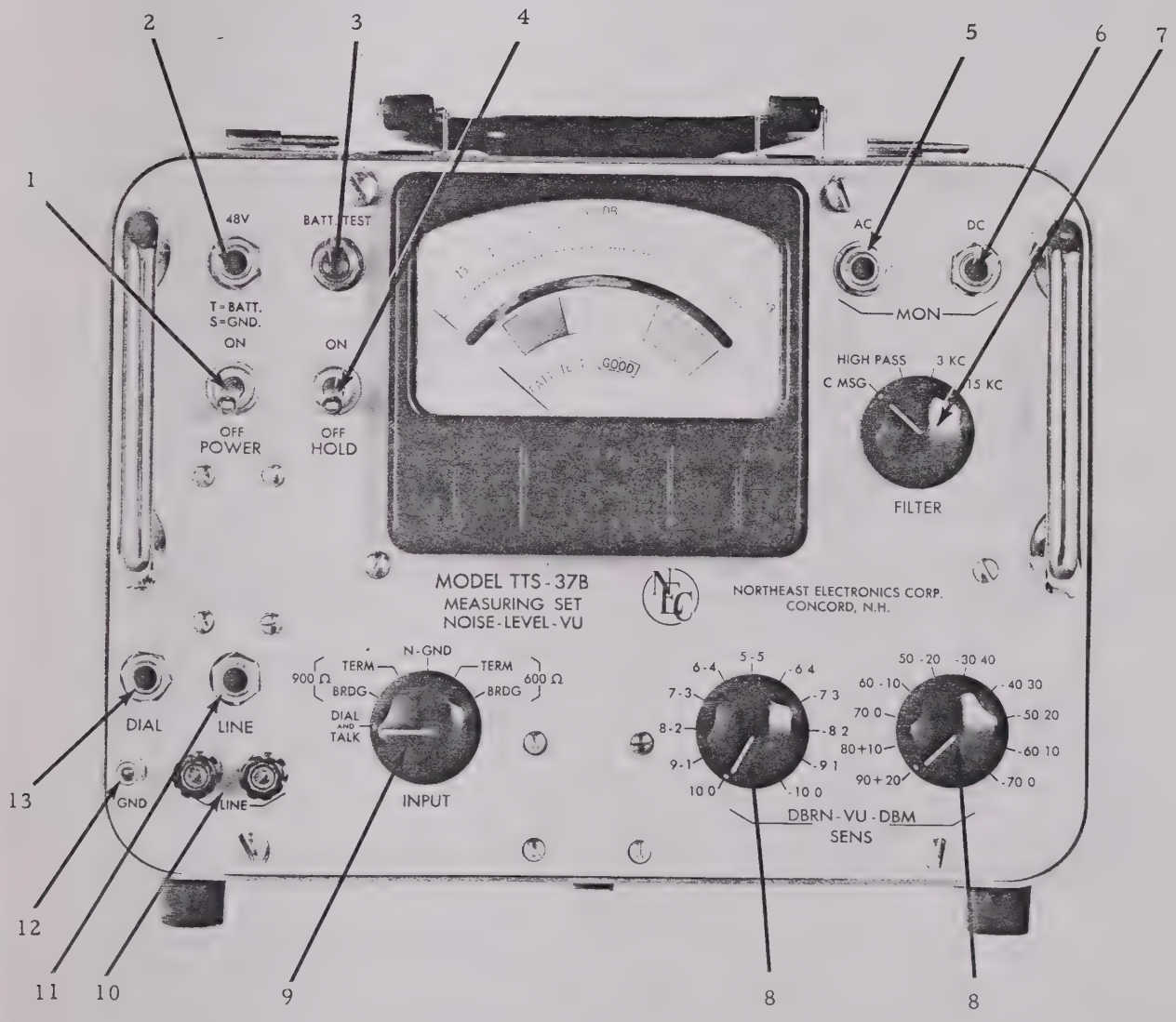


Fig. 3-1 Front Panel Controls

c. Operate POWER switch to ON.

d. Depress BATT TEST key and observe correct polarity and voltage by meter needle swinging to the green arc (GOOD).

e. To disconnect the 48 volts, first remove the connection of 48 volts from cord, then remove 310 plug from 48V jack.

3.10 TO DC MONITOR OR RECORD

a. Follow normal procedure under 3.3 and 3.4.

CAUTION: The external DC monitor (recorder for meter) device must have a relatively low resistance (not over 300Ω) and must be isolated from ground.

b. Connect monitoring device to DC MON jack (tip and ring). If monitoring devices resistance is correct, there will be no change in reading on 37B meter.

c. Calibrate external monitor. (odB meter reading will produce approximately 0.7 mA.

3.11 STORAGE. Always attach lid to test set when not in use. This automatically turns POWER switch OFF when closed.

SECTION 4

CIRCUIT DESCRIPTION

4.1 CIRCUIT DESCRIPTION (See Fig. 7-1) The gain of the set is obtained from three amplifiers. Each amplifier is enclosed with a large amount of negative feedback to ensure gain stability. The inherent noise level of the set is at least -100 dBm and approaches -120 dBm when the C message filter is used. The unit can be divided into the following basic circuits.

a. Input circuit
b. 10 dB step attenuator
c. Amplifier 1
d. Filter switching network
e. 1 dB step attenuator
f. Amplifier 2
g. Amplifier 3
h. Metering circuit
i. Monitoring circuits
j. Power section

4.2 INPUT CIRCUIT. The input line connections are made to a balanced transformer with dc blocking capable of withstanding 150 V dc of either polarity. Terminating resistors for 600 and 900 ohm input impedances can be switched directly across the input line and the dc blocking is still maintained. These resistors and the hold coil, which can be switched across the line, are switched at the equal potential or center-tapped position to maintain balance. The input circuit is balanced at least 80 dB at 60Hz, 70 dB at 1000 Hz and better than 60 dB up to 10 kHz. A longitudinal drain, whose center tap is connected to ground through a resistor, is supplied.

4.3 The transformer has a 1:1 ratio. Since the secondary of this is loaded by a high impedance, the primary of the transformer also looks like a high impedance. This reflected impedance is seen in the bridging positions of the INPUT switch. It is nominally 12,000Ω for 600Ω circuits and 15,000Ω for 900Ω circuits; the bridging losses will be less than 0.2 dB for frequencies down to approximately 100 Hz.

4.4 10 dB STEP ATTENUATOR. This attenuator, which is the main sensitivity adjustment of the set, provides 0 to 90 dB of attenuation in 10 dB steps. Five "L" pads having losses of 10, 20, 30, 40 and 50 dB are inserted to provide the 0 to 50 dB of attenuation in 10 dB steps. The 60, 70, 80, 90 dB steps are the result of combining the 50 dB pad with the 10, 20, 30, 40 dB pads respectively.

4.5 AMPLIFIER 1. This amplifier is a 3-stage amplifier having a voltage gain of approximately 30 dB. The input impedance is approximately 20,000Ω and output impedance is built-up to approximately 600Ω with a series resistance to match the input impedances of the filters.

4.6 FILTER SWITCHING NETWORK. Selects the proper filter network to produce the response shown in Figs. 2-1 and 2-2. The insertion loss is approximately 12 dB. The overall gain of the unit is calibrated with the 15 KC filter switched in. This position has no provision for loss adjustment. Once the overall gain has been set, the remaining filters are alternately selected and with the potentiometers provided, the loss of these filter positions are normalized with that of the 15 KC position.

4.7 1 dB STEP ATTENUATOR. This is a conventional stepped voltage divider which presents a 600Ω impedance to the filter and is terminated by the high impedances of Amplifier 2. One-half percent ($\frac{1}{2}$%) resistors are used to assure an accuracy better than $\pm$0.15 dB.

4.8 AMPLIFIER 2. This circuit is a 3-stage amplifier having a voltage gain of approximately 50 dB. Since the input impedance is greater than 30,000Ω, any change in output impedance of the 1 dB step attenuator, when changing attenuator steps will be negligent. Attenuator output impedance change is approximately 600 to 200Ω.

4.9 AMPLIFIER 3. This circuit is a 2-stage amplifier which drives a complementary pair of transistors that rectify the sinusoidal signal similar to that of a diode bridge. The use of transistors rather than diodes provides current gain, allowing greater dynamic range. The meter movement, requiring dc current, is driven alternately on each half cycle from the complementary pair of transistors. The

rectified half cycles of current are re-combined through capacitors to form a sinusoidal Signal from which negative feedback to the first stage is provided. This configuration having the rectifying elements and meter enclosed within the negative feedback loop provides greater circuit stability when subject to temperature change and provides linear output, meter reading vs input voltage.

4.10 METERING CIRCUIT. The terminals of the meter are wired through the BATT TEST pushbutton switch so that when depressed, the meter is removed from the amplifier detector circuit and connected between the internal battery and ground through a dropping resistor which converts the milliammeter into a voltmeter to monitor the condition of the battery.

4.11 MONITORING CIRCUITS. The DC MON jack provides a means to connect an external milliammeter or recorder in series with the meter of the set. The characteristics of Amplifier 3, with the bridge incorporated in the feedback loop, produce a high impedance or constant source for the meter. Thus, the external meter can have a wide range of resistance. It is advisable, to ensure maximum accuracy of reading. to keep this resistance of the external meter recorder below 300Ω. It is also necessary to keep the external meter or recorder isolated from ground electrically since part of the feedback would be shorted out. Whenever the meter reads 0 dBm, the available current is approximately 0.7mA.

4.12 The AC MON circuit consists of Q211, which samples part of the signal available in Amplifier 3, amplifies it, and provides a given source of impedance available to the AC MON jack. The signal which this amplifier samples is at the emitter of Q207 in Amplifier 3. This is a sine wave, and is still a direct function of the signal appearing at the line jacks. The input impedance of the monitor amplifier Q211 is high enough so that it does not shunt the emitter resistance of Q207 and therefore it does not materially influence the amount of feedback or the value of the gain of either Amplifier 3 or the entire set. To conserve internal battery power, the collector supply of Q211 is normally cut off until the plug is inserted into the AC MON jack. The signal available at the AC MON jack is dc blocked so that a dc resistance can be inserted between the tip and ground of the jack. This dc blocking is done by a 20μF 25V electrolytic capacitor which means that if any dc voltage should be applied to the tip of the AC MON jack, it should not exceed 9V negative which would reverse bias the capacitor, or 12volt positive which would exceed the voltage rating of the capacitor.

4.15 POWER SECTION. The set operates from two sources of power: 18 volt internal battery and 48 volt CO battery. When operating from the internal battery, the 18 volts is dropped to approximately 12 volts by a zener diode regulator circuit. This regulated supply serves all circuits in the set. When operating from the CO battery, the internal battery becomes disconnected from the 12V regulator and 48 volts is applied to a 24 volt zener diode regulator circuit. This regulated 24 volts is now connected to the input of the 12 volt regulator circuit.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 BATTERY REPLACEMENT. To replace batteries, perform the following steps;

a. Remove set from the case by loosening the four captive screws on the front panel.

b. Disconnect the red and black wires from the batteries.

c. Remove the battery retaining plate.

d. Remove old batteries and replace with new ones.

e. Connect the red and black wires to the batteries and replace battery retaining plate.

f. Turn POWER switch on and check batteries by depressing BATT TEST pushbutton - Meter should indicate in green arc.

g. If batteries check OK, replace set in case and tighten the four captive screws.

5.2 MAINTENANCE. In the event of an inaccurate or missing meter indication, the following checks should be made:

a. Check batteries. When the BATT TEST pushbutton is depressed the meter should indicate in the green arc, if not, the batteries should be replaced. (Refer to paragraph 5.1).

b. Check for correct control settings as follows:

FUNCTION switch - set in desired function.

SENS - to be of sufficient sensitivity to give a reading.

INPUT - Connected signal to proper jack or pair of terminals. (preferably 1kHz)

DC MON - If used, plug must have low dc resistance.

FILTER - set to desired position.

c. If all controls are set correctly and batteries check OK and the meter indication is still incorrect, the internal circuits can be checked.

5.3 INPUT CIRCUIT CHECK. Remove set from case and proceed as follows:

a. Place SENS switch in -70 dB position.

b. Place INPUT switch in either 600 TERM or 600 BRDG position.

c. Place POWER switch in OFF position.

d. Connect a 1000 Hz, 0 dBm signal (NEC TTS 43A or equivalent) to the LINE jack.

e. With a VTVM or an oscilloscope, check for approximately 2 volts peak to peak at pin 7 of transformer T1. The same signal should also appear at the wiper of deck 2A of switch S5 (INPUT) and the wiper of deck 1 of switch S4 (SENS). This signal should also appear at the base of transistor Q201 (pin 24 of printed circuit board).

5.4 AMPLIFIER #1 CHECK. (Q201, Q202, and Q203).

a. Turn POWER switch to ON

b. Set -10 dB/step attenuator to -40 dBm.

c. Connect an oscilloscope to pin 23 of the printed circuit board. (output of amplifier #1). The level at this point should be approximately 1.5V peak to peak. If there is no output or it is very low, proceed to the next step.

d. Remove signal from INPUT terminals; measure the dc voltages at the collector of Q201 and Q202 and at the emitter of Q203. (Refer to schematic diagram 6-1.)

CAUTION: When checking dc voltages, use a VTVM (20,000Ω per volt) on the 10V scale.

5.5 FILTER CHECK

a. Connect 1000 Hz 0 dB signal to the INPUT terminals and set the 10 dB/step attenuator to -40 dBm and the 1 dBm/step attenuator to -10 dBm.

b. Connect an oscilloscope to pin 9 on the printed circuit board. The signal here should be approximately 0.3 V peak to peak.

5.6 AMPLIFIER #2 CHECK. If previous steps are correct, proceed as follows:

a. Place both SENS switches in the 0 dBm position.

b. With an oscilloscope check the level at the collector of transistor Q206. This should be approximately 0.4V peak to peak.

c. If this voltage is not correct, check the dc voltages in the same manner as in paragraph 5.4d observing the CAUTION.

5.7 AMPLIFIER #3 CHECK.

a. This amplifier is checked in the same way as is amplifier #2. The level at the collector of Q208 should be approximately 2V peak to peak. and should appear flattened.

b. When checking the dc voltages in this circuit, observe the CAUTION under paragraph 4.3d.

5.8 CALIBRATION. If calibration of the set is required, perform the following:

a. Set front panel controls:

INPUT	TERM 600Ω
HOLD	OFF
POWER	ON
SENS	Both controls at 0 dBm
FILTER	15 KC

b. Connect a 0 dBm, 1000 Hz signal to the LINE jack and adjust R234 for 0 dBm on the front panel meter.

c. Repeat for the 3 KC position of the FILTER switch and adjust R217 for 0 dBm on the meter.

d. Repeat for the HIGH PASS position of the FILTER switch and adjust R215 for 0 dBm on the meter.

e. Repeat for the C MSG position of the FILTER switch and adjust R213 for 0 dBm on the meter.

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 37B.

6.2 FSCM CODE NUMBERS. The Federal Supply Code of Manufacturers of each part. A list of manufacturers and their respective code numbers is given below.

Code No.	Manufacturer
01121	Allen Bradley
04009	Arrow-Hart & Hegeman
05397	Kemet
05844	Callins
06819	NEC
07716	IRC
09653	IEI
06555	Beede Electrical Instrument Co.
12065	Transitron
13606	Sprague
15873	Motorola
17803	Fairchild
17117	Electronic Moulding Corp.
22650	Whale Electronics
71590	Centralab
76854	Oak Manufacturing Co.
72136	Electro Motive Mfg. Co., (Elmenco)
80223	UTC
81095	Triad
82389	Switchcraft
83330	H. H. Smith
84171	Arco

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R101 and R106	R: 42.2K ±1% 1/8W	07716	CEA
R102	R: 84.5K ±1% 1/8W	07716	CEA
R103	R: 1.07K ±1% 1/8W	07716	CEA
R104	R: 4.53K ±1% 1/8W	07716	CEA
R105 and R108	R: 475Ω ±1% 1/8W	07716	CEA
R107 and R109	R: 316Ω ±1% 1/8W	07716	CEA
C101	C: 100μF 150V	22650	34-875-100-150-8NA

E-14-037-20-006

Q201	Transistor	15873	2N3905
Q202	Transistor	15873	2N3903
Q203	Transistor	15873	2N3905
Q204	Transistor	15873	2N3905
Q205	Transistor	15873	2N3903
Q206	Transistor	15873	2N3905
Q207	Transistor	15873	2N3905
Q208	Transistor	15873	2N3905
Q209	Transistor	15873	2N3903
Q210	Transistor	15873	2N3905
Q211	Transistor	15873	2N3905
Q212	Transistor	17803	2N4356
CR201	Diode	12065	1N4148
CR202	Diode	12065	1N2069
CR203	Diode 24V zener	12065	1N3029B
CR204	Diode 13V zener	15873	1N964B
CR205	Diode	12065	1N4148
R201	R: 820K ±10% ½W	01121	RC20
R202	R: 120K ±10% ½W	01121	RC20
R203	R: 47Ω ±1% 1/8W	07716	CEA
R204	R: 3.9K ±5% ½W	01121	RC20
R205	R: 100Ω ±10% ½W	01121	RC20
R206	R: 10K ±10% ½W	01121	RC20
R207	R: 1.5K ±1% 1/8W	07716	CEA
R208	R: 562Ω ±1% ½W	07716	CEA
R209	R: 680Ω ±5% ½W	01121	RC20
R210	R: 620Ω 5% ½W	01121	RC20
R211	R: 1.8K ±5% ½W	01121	RC20
R212	R: 56Ω ±5% ½W	01121	RC20
R213	Pot: 200Ω	07716	UPE-200RE-1
R214	R: 910Ω ±5% ½W	01121	RC20
R215	R: 500Ω pot	07716	UPE-200RE-1
R216	R: 620Ω ±5% ½W	01121	RC20

E-14-037-20-006 (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R217	Pot: 500Ω	07716	UPE-200RE-1
R218	R: 910Ω ±5% ½W	01121	RC20
R219	R: 620Ω ±5% ½W	01121	RC20
R220	R: 1.2K ±10% ½W	01121	RC20
R221	R: 620Ω ±5% ½W	01121	RC20
R222	R: 100K ±10% ½W	01121	RC20
R223	R: 220K ±10% ½W	01121	RC20
R224	R: 3.9K ±5% ½W	01121	RC20
R225	R: 15Ω ±1% 1/8W	07716	CEA
R226	R: 390Ω ±10% ½W	01121	RC20
R227	R: 560K ±10% ½W	01121	RC20
R228	R: 3.9K ±5% ½W	01121	RC20
R229	R: 4.64K ±1% 1/8W	07716	CEA
R230	R: 4.3K ±5% ½W	01121	RC20
R231	R: 220K ±10% ½W	01121	RC20
R232	R: 3.9K ±5% ½W	01121	RC20
R233	R: 143Ω ±1% 1/8W	07716	CEA
R234	Pot: 100Ω	07716	UPE-200RE-1
R235	R: 178Ω ±1% 1/8W	07716	CEA
R236	R: 150K ±5% ½W	01121	RC20
R237	R: 20K ±5% ½W	01121	RC20
R238	R: 390Ω ±10% ½W	01121	RC20
R239	R: 390Ω ±10% ½W	01121	RC20
R240	R: 200K ±5% ½W	01121	RC20
R241	R: 680Ω ±5% ½W	01121	RC20
R242	R: 200Ω ±5% ½W	01121	RC20
R243	R: 10K ±10% ½W	01121	RC20
R244	R: 27K ±5% ½W	01121	RC20
R245	R: 680Ω ±5% ½W	01121	RC20
R246	R: 10K ±10% ½W	01121	RC20
R247	R: 560K ±10% ½W	01121	RC20
R248	R: 20K ±5% ½W	01121	RC20
R249	R: 470Ω ±10% ½W	01121	RC20
R250	R: 100Ω ±10% ½W	01121	RC20
R251	R: 100Ω ±10% ½W	01121	RC20
C201	C: 22μF 6V	05397	K22W6K
C202	C: 510pf 1K	71590	DD-511
C203	C: 0.22μF 50K	05397	KR22W50K
C204	C: 100μF 20V	09653	APD-095
C205	C: 0.01μF 100V	13606	225P
C206	C: 20μF 25V	09653	APD-046
C207	C: 1.0μF	13606	5C13
C208	C: 0.2μF 75V	13606	225P
C209	C: 0.2μF 75V	13606	225P
C210	C: 0.15μF 75V	13606	225P
C211	C: 0.27μF 75V	72136	IMD-3-274
C212	C: 0.22μF 75V	72136	IMD-3-224
C213	C:0.33μF 75V	13606	225P
C214	C: 0.27μF 75V	13606	225P
C215	C: 0.04μF 100V	84171	IDP-1-403
C216	C: 0.04μF 100V	84171	IDP-1-403
C217	C: 0.0068μF 100V	13606	225P

Ref. Desig.	Description	Mfr. Code (FSCM Code No.)	Part Number
C218	C: 0.0068μF 100V	13606	225P
C219	C: 20μF 25V	09653	APD-046
C220	C: 2.2μF 35V	05397	K2R2W35K
C221	C: 0.15μF 75V	13606	225P
C222	C: 4.7μF 25V	05297	K4R7W25K
C223	C: 0.1μF 50V	05397	KR1W50K
C224	C: 100μF 20V	05844	APD-095
C225	C: 0.0047μF 100V	13606	225P
C226	C: 10μF 10V	05397	K10W10K
C227	C: 10μF 10V	05397	K10W10K
C228	C: 0.1μF 75V	71590	DDA-104
C229	C: 20μF 25V	09653	APD-046
C230	C: 0.1μF 100V	05844	APD-127
C231	C: 100μF 50V	05844	APD-127
C232	C: 100μF 20V	05844	APD-095
C233	C: 20μF 25V	09653	APD-046
C234	C: 0.33μF 75V	13606	225P
L201	Ind: 30MH coils	81095	EC-030
L202	Ind: 30MH coils	81095	EC-030
L203	Ind: 150MH coils	81095	EC-150
L204	Ind: 150MH coils	81095	EC-150
L205	Ind: 30MH coils	81095	EC-030

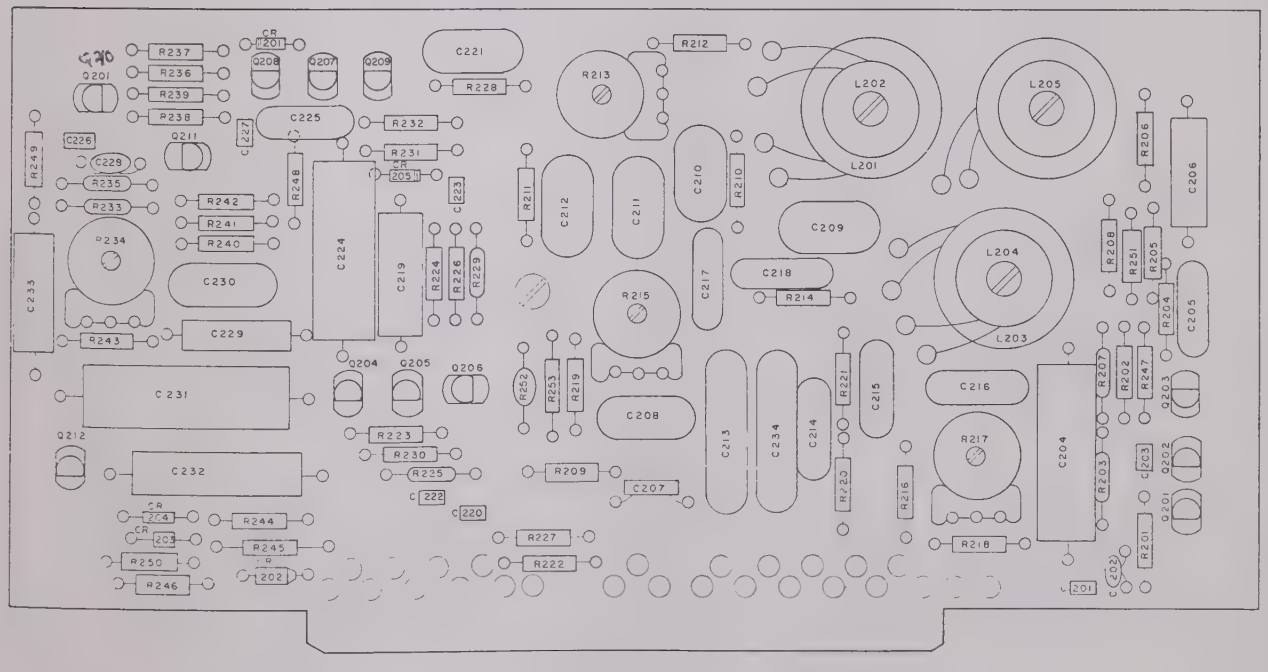


Fig. 6-1 Component Location E-14-037-20-006

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
S7	Switch: rotary	76854	269425-F4
R1, R10, R11	R: 20K ±½% 1/8W	07716	CEA
R2	R: 63.4Ω ±½% 1/8W	07716	CEA
R3	R: 205Ω ±½% 1/8W	07716	CEA
R4 and R14	R: 13.7K ±½% 1/8W	07716	CEA
R5	R: 649Ω ±½% 1/8W	07716	CEA
R6	R: 46.4K ±½% 1/8W	07716	CEA
R7	R: 2K ±½% 1/8W	07716	CEA
R8	R: 196K ±½% 1/8W	07716	CEA
R9	R: 6.34K ±½% 1/8W	07716	CEA
R12	R: 19.6 K ±½% 1/8W	07716	CEA
R13	R: 17.8K ±½% 1/8W	07716	CEA
S6	S: rotary	76854	269428
R15	R: 22.6Ω ±½% 1/8W	07716	CEA
R16	R: 26.1Ω ±½% 1/8W	07716	CEA
R17	R: 29.4Ω ±½% 1/8W	07716	CEA
R18	R: 33.2Ω ±½% 1/8W	07716	CEA
R19	R: 36.5Ω ±½% 1/8W	07716	CEA
R20	R: 41.2Ω ±½% 1/8W	07716	CEA
R21	R: 46.4Ω ±½% 1/8W	07716	CEA
R22	R: 52.3Ω ±½% 1/8W	07716	CEA
R23	R: 59Ω ±½% 1/8 W	07716	CEA
R24	R: 66.5Ω ±½% 1/8W	07716	CEA
R25	R: 191Ω ±½% 1/8W	07716	CEA
T1	Transformer	80223	A-20 or GR-815
L1	Hold coil	06819	TN 1274
S1	S: toggle DPDT	04009	81027CB
S2	S: toggle SPDT	04009	81015K
S3	S: pushbutton	82389	NF-4006
S4	S: rotary	76854	269431-F2
S5	S: pushbutton	76854	272837K3
J1, J2, J5	Jacks: telephone	82389	M444B
J3, J4	Jacks: telephone	82389	M446A
J6, J7	Binding posts (LINE)	EMC*	5595-175-2
TP-1	Binding posts (GND)	83330	137SP
	Meter	06555	7685

SECTION 7

SCHEMATIC DIAGRAM

7.1 INTRODUCTION. This section contains the schematic diagrams for the Models TTS 37B, TTS 37B-1, TTS 37B-3 and TTS 37B-15.

TTS 37B ADDENDUM 1

1. Add the following note to the operating procedure:

NOTE

The portable version of this instrument has been calibrated with the meter in the horizontal position and the rack-mounted version with the meter in the vertical position. To obtain the specified accuracy, the instrument must be operated in the same position in which it was calibrated. If it is desired to operate the instrument in another position, the instrument must be recalibrated while the meter is in the desired position.

2. Make the following changes to the E-14-037-20-006 parts list on page 6-3.

C207	C: 1.0μF	72982	8131-100-651-105M
C208	C: 0.2μF,100V	72136	1PJ-204F
C209	C: 0.2μF,100V	71236	1PJ-204F
C210	C: 0.15μF,100V	24446	AF12B1549D

TTS 37B ADDENDUM 2

1. In paragraph 2.4, 15 kHz specification, change:

   13 kHz to 15 kHz; to read: 13 kHz to 16 kHz.

2. In paragraph 2.8a, change:

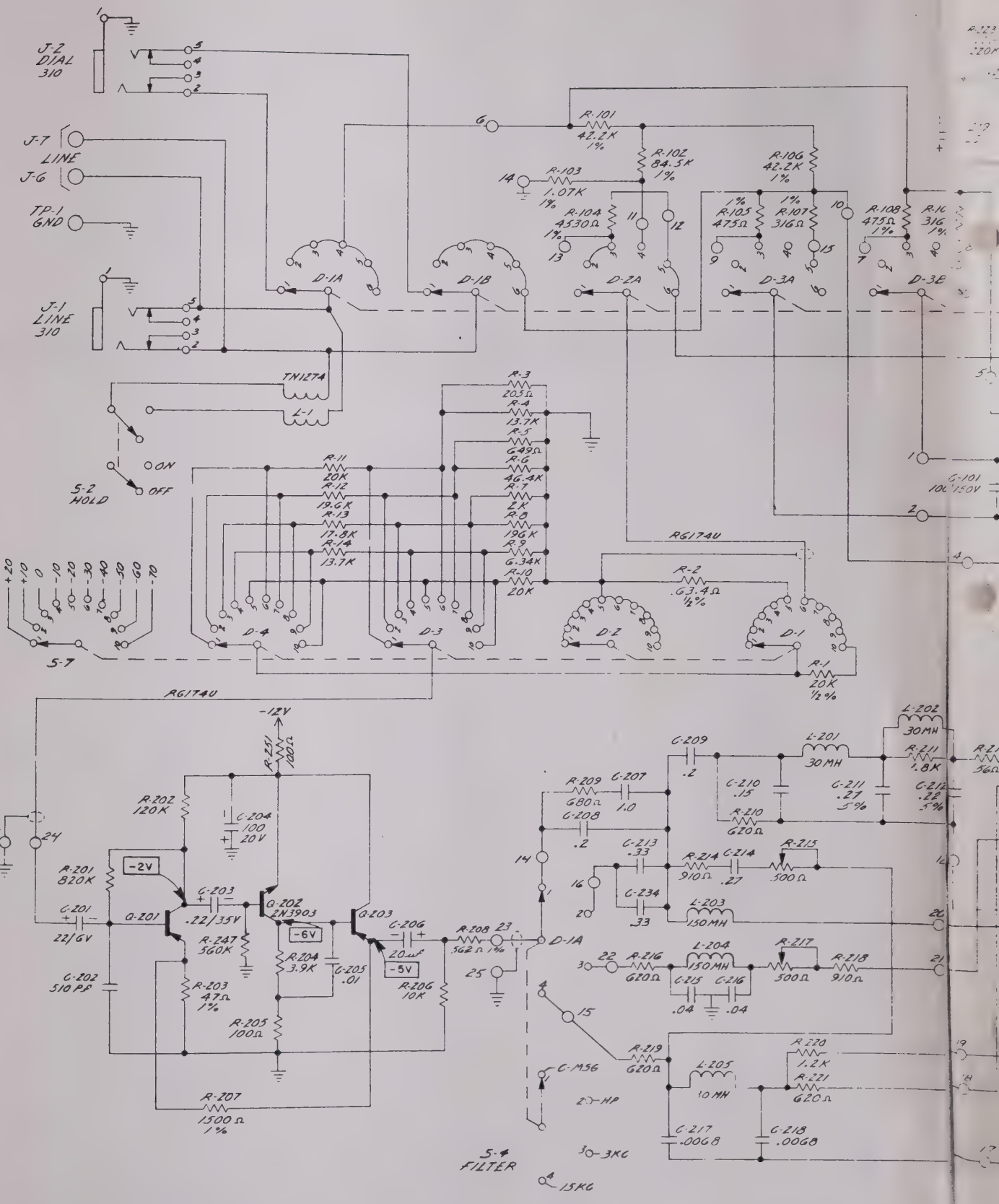
   0 dBm to read 0 dB.

ADDENDUM SHEET TTS 37B-1

The TTS 37B-1 is a basic TTS 37B with an EXT position added on the FILTER switch and the hold coils wired differently across the LINE jacks so that the hold coils are not in the dialing circuits. When the FILTER switch is in the EXT position an extra 10 dB of gain is supplied by the meter amplifier.

PARTS LIST ADDENDUM

REF DESIG.	DESCRIPTION	MANUFACTURER (FSCM CODE #)	PART Number
S-4	S: switch rotary	71590	PA-1020
R-52	R: Sel. Val.	01121	RC20
R-53	R: Sel. Val.	07716	CEA


J-2 DIAL 310
J-7 LINE
J-6
TP-1 GND
J-1 LINE 310
T N1274
L-1
S-2 HOLD
ON
OFF
S-7
D-1A
D-1B
D-2A
D-3A
D-3B
D-4
D-3
D-2
D-1
R-101 42.2K 1%
R-102 84.5K 1%
R-103 1.07K 1%
R-104 4530Ω 1%
R-105 475Ω 1%
R-106 42.2K 1%
R-107 316Ω 1%
R-108 475Ω 1%
R-1 20K ½%
R-2 63.4Ω ½%
R-3 205Ω
R-4 13.7K
R-5 649Ω
R-6 46.4K
R-7 2K
R-8 19GK
R-9 6.34K
R-10 20K
R-11 20K
R-12 19.6K
R-13 17.8K
R-14 13.7K
RG174U
+20 +10 0 -10 -20 -30 -40 -50 -60 -70
-12V
R-251 120Ω
R-202 120K
C-204 100 20V
R-201 820K
-2V
C-201 22/6V
Q-201
C-203 .22/35V
Q-202 2N3903
Q-203
-6V
R-247 560K
R-204 3.9K
C-205 .01
C-206 20μf
-5V
R-206 10K
C-202 510 PF
R-203 47Ω 1%
R-205 100Ω
R-207 1500Ω 1%
R-208 562Ω 1%
C-209 .2
C-207 1.0
R-209 680Ω
C-208 .2
C-210 .15
C-211 .27 5%
C-212 .22 5%
L-202 30MH
L-201 30MH
R-211 1.8K
R-210 620Ω
C-213 .33
R-214 910Ω
C-214 .27
R-215 500Ω
C-234 .33
L-203 150MH
R-216 620Ω
L-204 150MH
C-215 .04
C-216 .04
R-217 500Ω
R-218 910Ω
R-219 620Ω
C-M56
L-205 10MH
R-220 1.2K
R-221 620Ω
C-217 .0068
C-218 .0068
20-HP
30-3KC
4-15KC
5-4 FILTER

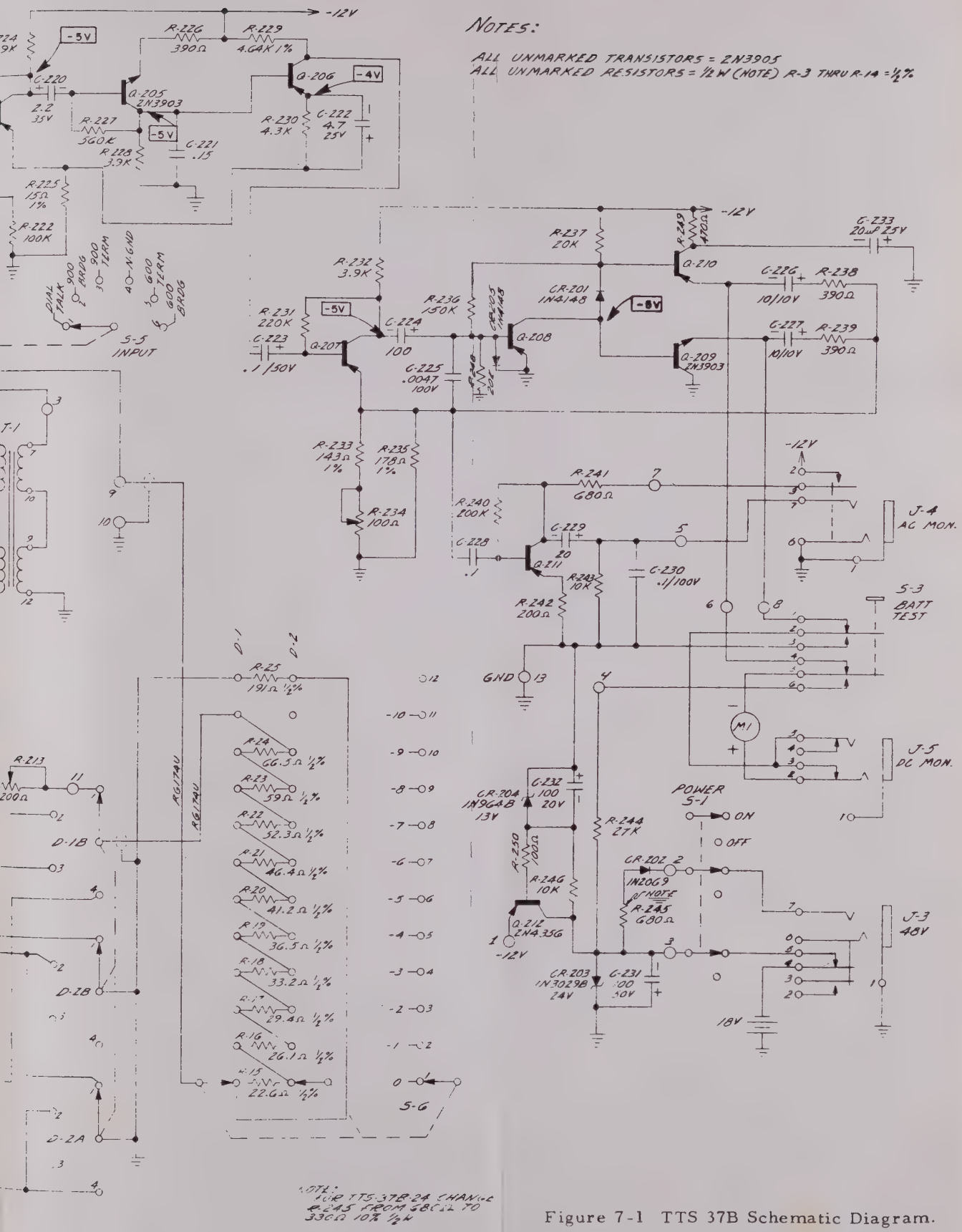
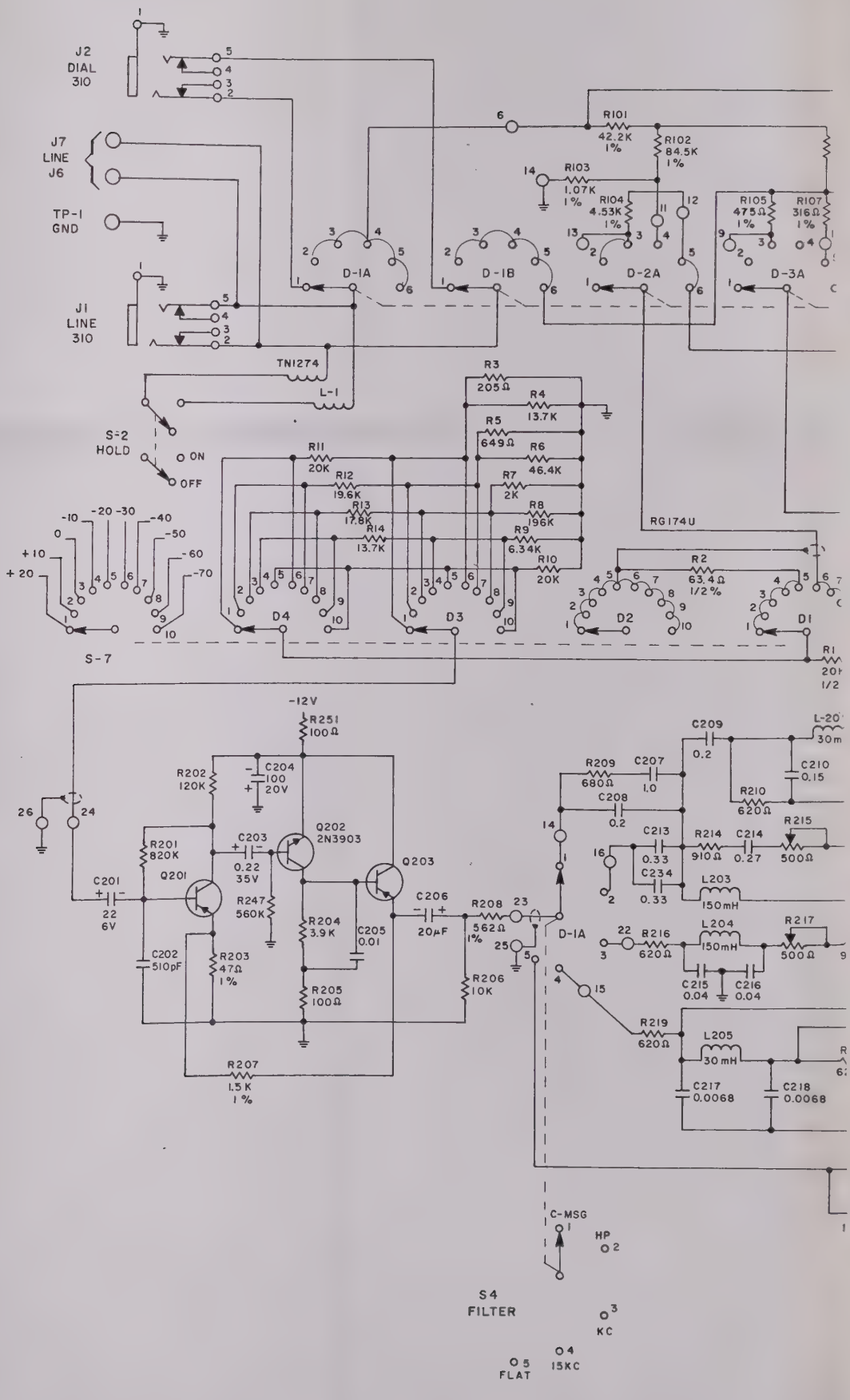


Figure 7-1 TTS 37B Schematic Diagram.


J2
DIAL
310
J7
LINE
J6
TP-1
GND
J1
LINE
310
TN1274
L-1
S-2
HOLD
ON
OFF
S-7
D-1A
D-1B
D-2A
D-3A
D1
D2
D3
D4
R101
42.2K
1%
R102
84.5K
1%
R103
1.07K
1%
R104
4.53K
1%
R105
475Ω
1%
R107
316Ω
1%
R108
475Ω
1%
R3
205Ω
R4
13.7K
R5
649Ω
R6
46.4K
R7
2K
R8
196K
R9
6.34K
R10
20K
R11
20K
R12
19.6K
R13
17.8K
R14
13.7K
R2
63.4Ω
1/2%
RG174U
R1
20
1/2
-10
-20
-30
-40
-50
-60
-70
0
+10
+20
-12V
R251
100Ω
R202
120K
C204
100
20V
C201
22
6V
C202
510pF
C203
0.22
35V
R201
820K
Q201
Q202
2N3903
Q203
R247
560K
R204
3.9K
C205
0.01
R203
47Ω
1%
R205
100Ω
R207
1.5K
1%
C206
20μF
R208
562Ω
1%
R206
10K
C209
0.2
L-20
30m
R209
680Ω
C207
1.0
C210
0.15
R210
620Ω
C208
0.2
C213
0.33
C234
0.33
R214
910Ω
C214
0.27
R215
500Ω
L203
150mH
R216
620Ω
L204
150mH
R217
500Ω
C215
0.04
C216
0.04
R219
620Ω
L205
30 mH
C217
0.0068
C218
0.0068
C-MSG
HP
S4
FILTER
KC
15KC
FLAT

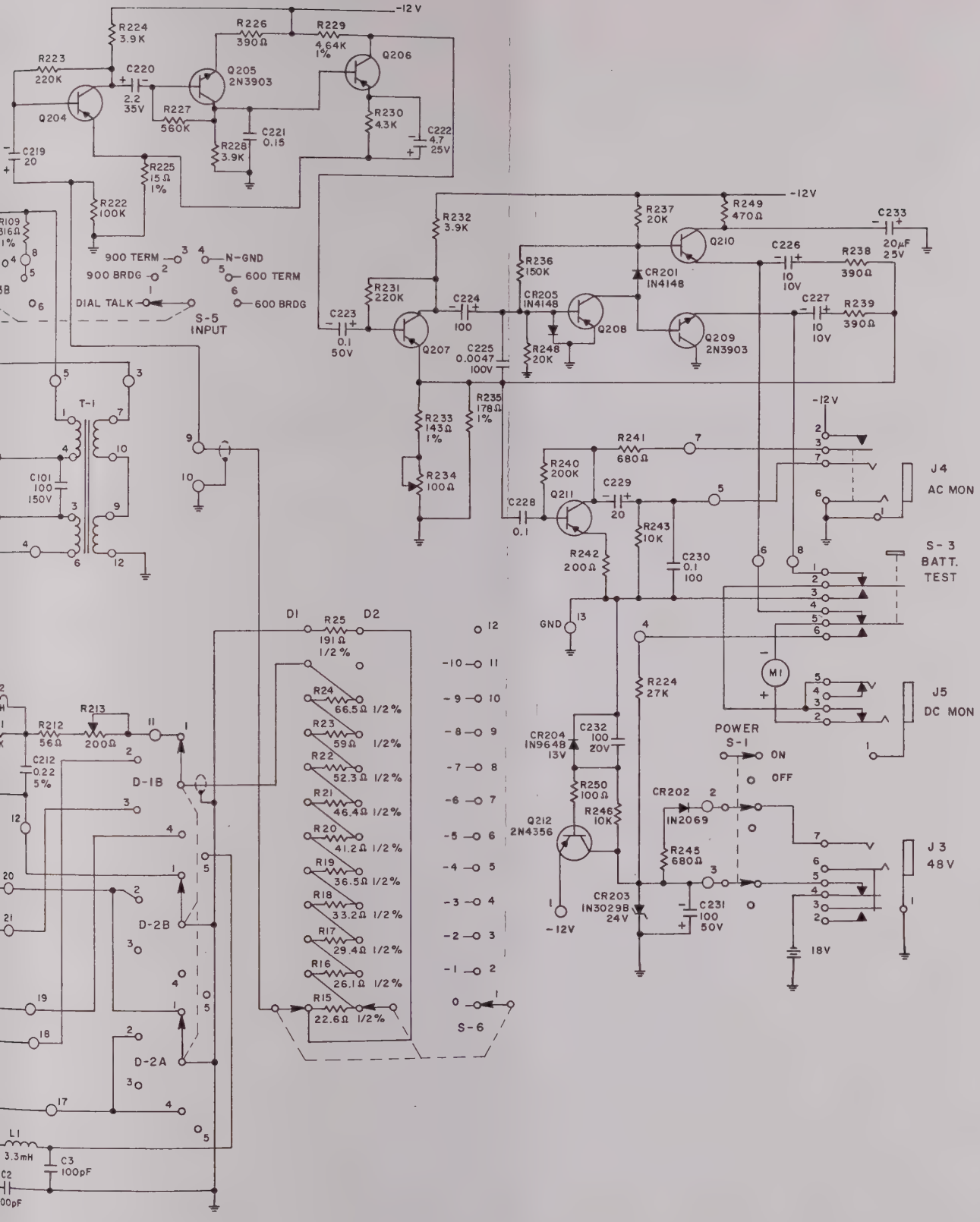
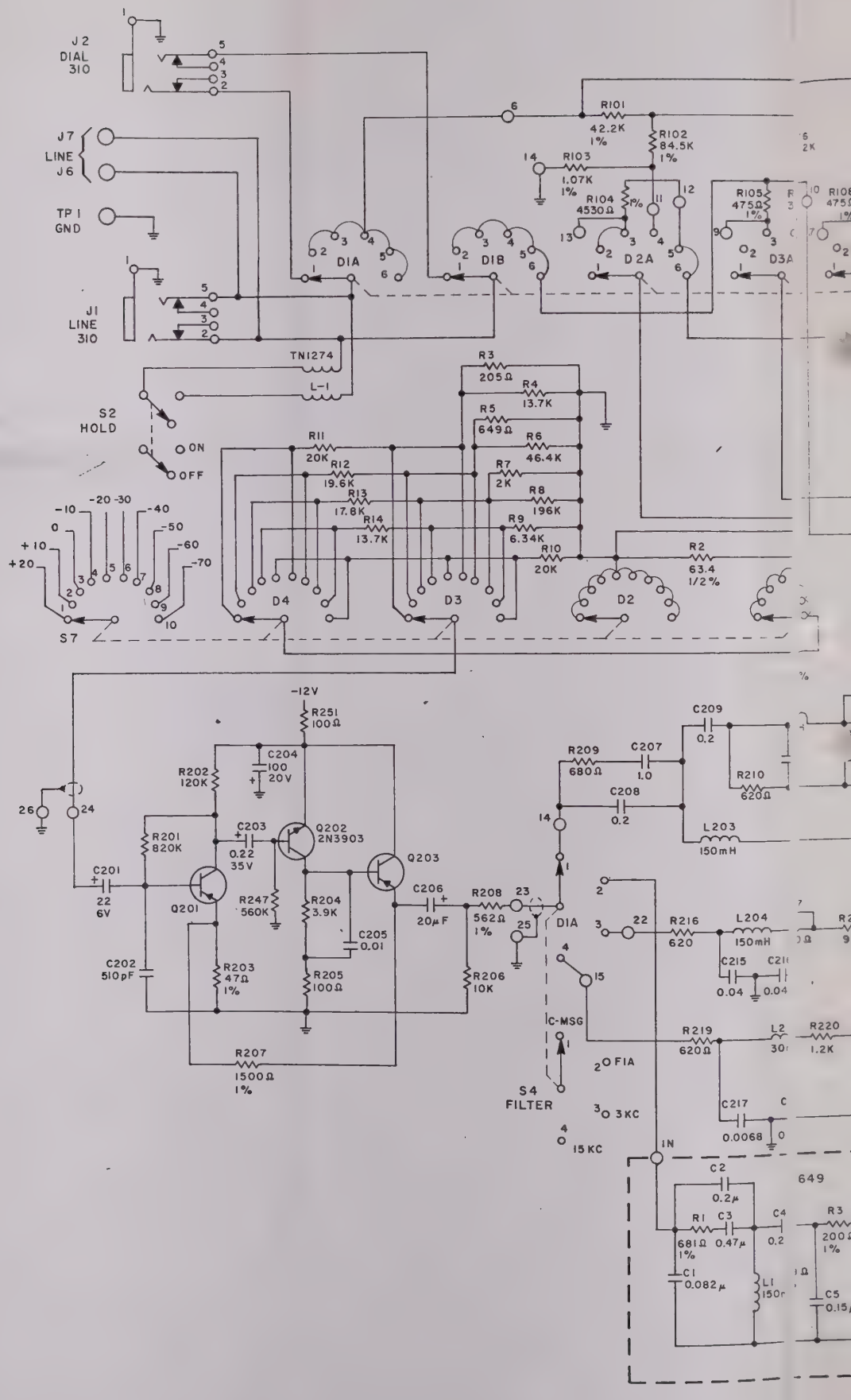


Figure 7-2. TTS 37B-1 Schematic Diagram


J2
DIAL
310
J7
LINE
J6
TP 1
GND
J1
LINE
310
S2
HOLD
ON
OFF
S7
TN1274
L-1
R101
42.2K
1%
R102
84.5K
1%
R103
1.07K
1%
R104
4530Ω
R105
475Ω
1%
R3
205Ω
R4
13.7K
R5
649Ω
R6
46.4K
R7
2K
R8
196K
R9
6.34K
R10
20K
R11
20K
R12
19.6K
R13
17.8K
R14
13.7K
R2
63.4
1/2%
D1A
D1B
D2A
D3A
D4
D3
D2
-12V
R251
100Ω
C204
100
20V
R202
120K
R201
820K
C203
0.22
35V
Q202
2N3903
Q203
Q201
C201
22
6V
R247
560K
R204
3.9K
C205
0.01
C206
20μF
R208
562Ω
1%
C202
510pF
R203
47Ω
1%
R205
100Ω
R206
10K
R207
1500Ω
1%
C209
0.2
R209
680Ω
C207
1.0
R210
620Ω
C208
0.2
L203
150mH
R216
620
L204
150mH
C215
0.04
R219
620Ω
R220
1.2K
C217
0.0068
S4
FILTER
C-MSG
FIA
3KC
15KC
DIA
IN
C2
0.2μ
R1
681Ω
1%
C3
0.47μ
C4
0.2
C1
0.082μ
L1
150
R3
200Ω
1%
C5
0.15
649

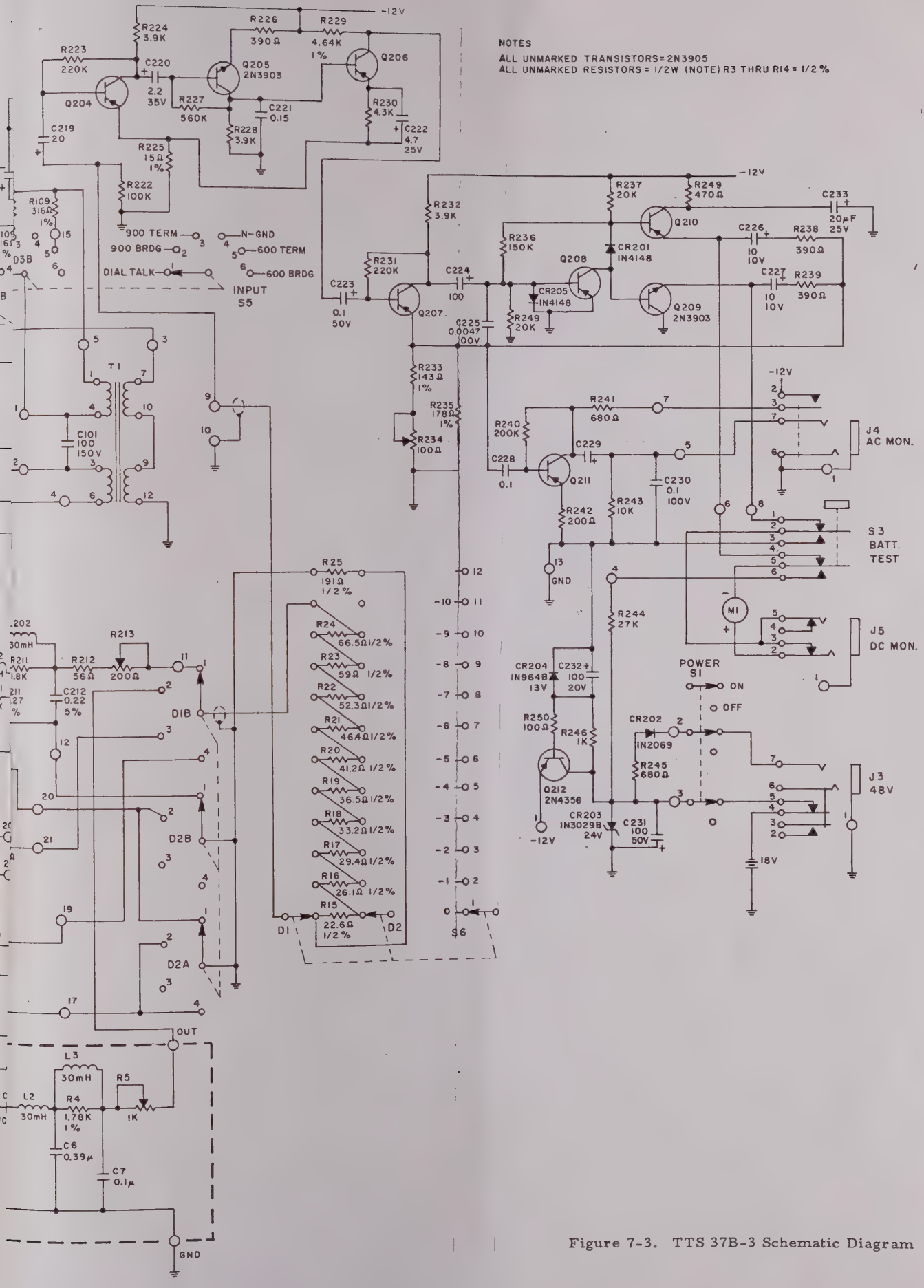
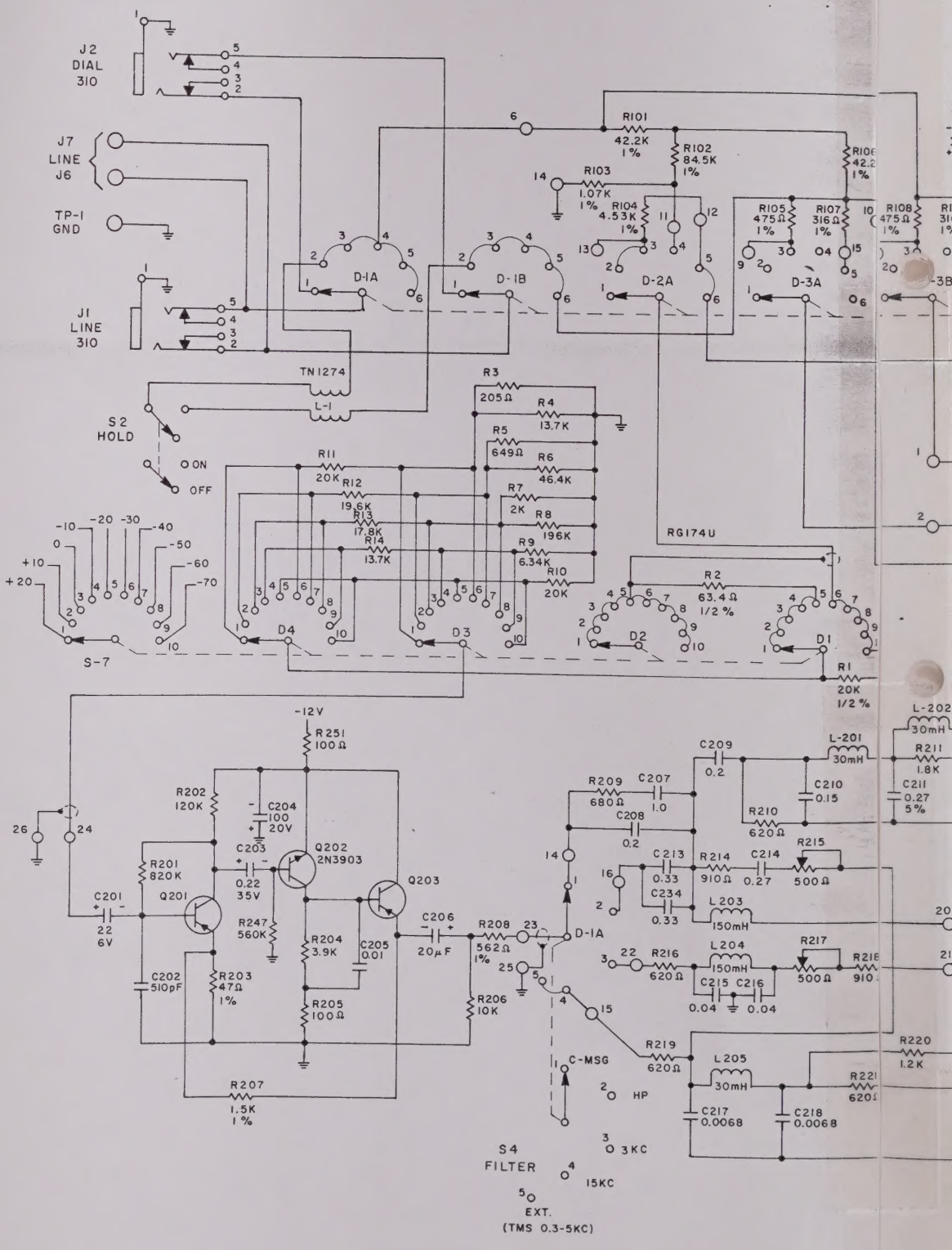


Figure 7-3. TTS 37B-3 Schematic Diagram


J2
DIAL
310
J7
LINE
J6
TP-1
GND
J1
LINE
310
R101
42.2K
1%
R102
84.5K
1%
R103
1.07K
1%
R104
4.53K
1%
R105
475Ω
1%
R107
316Ω
1%
R108
475Ω
1%
D-1A
D-1B
D-2A
D-3A
TN1274
L-1
S2
HOLD
ON
OFF
R3
205Ω
R4
13.7K
R5
649Ω
R6
46.4K
R7
2K
R8
196K
R9
6.34K
R10
20K
R11
20K
R12
19.6K
R13
17.8K
R14
13.7K
RG174U
R2
63.4Ω
1/2%
R1
20K
1/2%
D1
D2
D3
D4
S-7
-12V
R251
100Ω
R202
120K
C204
100
20V
C203
0.22
35V
Q202
2N3903
Q203
R201
820K
Q201
C201
22
6V
R247
560K
R204
3.9K
C205
0.01
C206
20μF
R208
562Ω
1%
C202
510pF
R203
47Ω
1%
R205
100Ω
R206
10K
R207
1.5K
1%
C209
0.2
L-201
30mH
R209
680Ω
C207
1.0
C208
0.2
C210
0.15
R210
620Ω
R211
1.8K
C211
0.27
5%
L-202
30mH
R215
C213
0.33
R214
910Ω
C214
0.27
500Ω
C234
0.33
L 203
150mH
L 204
150mH
R216
620Ω
R217
500Ω
C215
0.04
C216
0.04
R219
620Ω
L 205
30mH
C217
0.0068
C218
0.0068
R220
1.2K
C-MSG
HP
S4
FILTER
3KC
15KC
EXT.
(TMS 0.3-5KC)

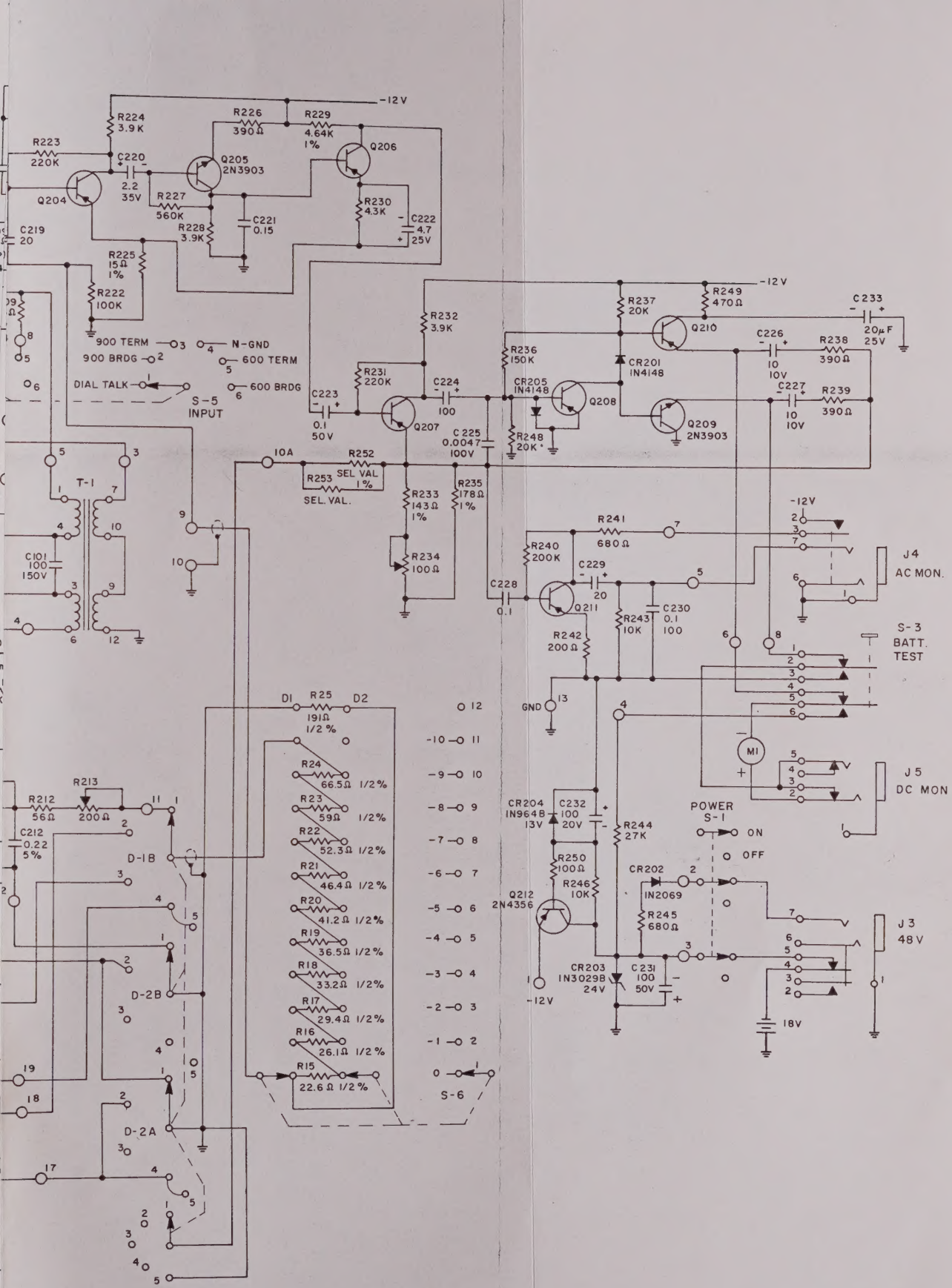


Figure 7-4. TTS 37B-15 Schematic Diagram